Modeling Seasonal Distribution and Density of Golden Eagles in the Western U.S. to Support Conservation Planning and Risk Assessment

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Goals and Objectives

• Provide risk assessment and decision support tools for renewable energy development and mitigation

• Develop landscape-scale strategies for Golden Eagle conservation

Photo: Gary Williams, USFWS
Breeding Areas

Movement & Migration Routes

Wintering Areas

Photo: Brian Woodbridge
I. Predictive Models of Golden Eagle Breeding Habitat
Modeling Approach

Objective: Reliable prediction of relative habitat suitability (relative density of use) at the scale of breeding territory

Ecoregion-specific

Species Distribution Models

Environmental variables:
- terrain, aspect, elevation
- land cover
- primary productivity (NDVI)
- climate
- anthropogenic features
- orographic uplift, thermals
Golden Eagle Breeding Habitat

Model Regions

Northwestern Plains
Wyoming and Uinta Basins
Central Basin and Range
Northern Great Basin
Columbia Plateau
Southwestern Plains
Southwestern Deserts
Intermontane Basins and Valleys
California Foothills
Southwestern Plateaus
Chihuahuan Desert*
Forested Montane*

*In development
Central Basin and Range

- 13,321 nest records
- 902 selected
Southwestern Deserts

- 1,096 nest records
- 288 selected
California Foothills
- 2,535 nest records
- 288 selected
- Model performance not evaluated yet
- Compare predictions in Diablo Range to Wiens et al. model?
California Foothills
Southern portion

- Draft model under review
- Nest data distribution clumped in project survey areas
California Foothills
Northern portion

• Draft model under review
• Evaluate nest data distribution
• Few surveys in forested habitats
Predictive Models of Golden Eagle Movements and Migration
Objectives -

- **Step 1:** Compile and analyze telemetry data (ARGOS, GPS, GSM) from cooperators throughout North America

- **Step 2:** Predictive models of movement ‘habitat’
  - Describe and map patterns of movement
  - Focus on landscapes and ecological conditions disproportionately used for movement and migration

**Core Team:**
Jessica Brown – U. Nevada, Reno
Dave LaPlante – NRG
Todd Katzner – USGS
Robert Murphy – USFWS
Todd Lickfett – USFWS
Carol McIntyre – NPS
Brian Woodbridge – USFWS

Photo: Sky Delite
Golden Eagle Telemetry Meta-analysis

- 32 collaborators
- 950 individual Golden Eagles tracked
- 7,782,583 locations

Data resource for multiple research projects
Collaborators  (AKA “Circle of Heroes”; Kochert 2015)

CA/NV area -
Doug Bell  -  East Bay Parks
Todd Katzner  -  USGS
Robert Fisher  -  USGS
Mark Fuller  -  USGS
Steve Slater  -  Hawkwatch Int.
Steve Lewis  -  Alaska Dept. Fish & Game
Joe Barnes  -  Nevada Dept. of Wildlife
Dave Bittner  -  WRI
Eric Hollingstad  -  WEST
Ken Jacobson  -  Arizona Dept. Game & Fish
Amy Fesncock  -  BLM
Mike Yates  -  Earth Span
Western Golden Eagle Team  -  USFWS
Factors influencing distribution and habitat use of Golden Eagles

- **Ecoregions**
  - Nonbreeding Season
  - Post-breeding Period
  - Migration Period
  - Nonbreeding Season

- **Temporal**
  - Breeding Season
  - Post-breeding Period

- **Age Class**
  - Adults
  - Subadults
  - Juveniles

- **Behavioral**
  - Territorial
  - Nonterritorial
  - Migratory
  - Nonmigratory
  - Dispersal
Northern Migrants (317)

- Eagles moving N of 55 N lat.
California/Nevada (R8)

- 245 individuals tracked
- 8 northern migrants
- 237 residents
Wyoming

- 264 individuals tracked
- 72 northern migrants
- 192 residents
Modeling approach:

Using Bayesian State-Space Switching model (‘“bsam” R-package) to discriminate:

- **Transiting** – directed long-distance movements
- **Sedentary** – localized movements

Develop separate RSF models for each behavior
Fall Transiting Model

- General model includes all age and behavior classes
Winter Sedentary Model

- General model includes all age and behavior classes
Space-use by Territorial Golden Eagles: a Meta-analysis
• Screened 192 candidate adult (AFY) eagles
• 109 had adequate data and exhibited territorial behavior
• Used consistent methods to estimate home range and core areas
Home range size - Geographic variation

- Cold Desert
- Mediterranean Calif
- NWForestMts
- WestCent Semiarid Prairies

95th percentile KDE Home Range (km^2)

Month
Core Area* size - Geographic variation